EOSDIS Test System (ETS) Scenarios

Prepared for

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1. Introduction

1.1 Overview

The Earth Observing System Data (EOS) and Information System (EOSDIS) Test System (ETS) provides the capability to test and simulate the EOS Ground System (EGS) and element interfaces. ETS simulates a limited number of EOS spacecraft telemetry functions, command processing, and ground system functions. To accomplish these functions, ETS has been divided into three major subsystems: ETS Low Rate System (ETS/LRS), ETS High Rate System (ETS/HRS) and ETS Multimode Portable Simulator (ETS/MPS). This document will provide the users of ETS with a general idea of the capabilities of ETS and how it can be used to test the EOS Ground System (EGS).

1.2 Purpose

The Earth Science Data and Information System (ESDIS) integration and test support team has identified seven primary scenarios in which ETS will be used to integrate EGS. These scenarios will be used to develop test cases that will test EGS interfaces.

1.3 Scope

This document provides the System Integration and Test (SI&T) Team with a baseline from which they will develop the test cases used to integrate the EGS. The descriptions presented in this document are limited to the operations of the AM-1 mission as the basis for discussion. However, these scenarios are applicable to all EOS missions and can be updated for multimission support.

1.4 Organization and Content

The ETS Operational Scenarios document is divided into four sections as follows:

- Section 1 contains the purpose and scope and the list of applicable documents.
- Section 2 describes the three ETS subsystems and provides an overview of the scenarios and their data flow.
- Section 3 describes the personnel responsibilities.
- Section 4 describes the ETS scenarios.

1.5 Applicable Documents

1. Consultative Committee for Space Data Systems, CCSDS 701.0-B-2, *Recommendation for Space Data System Standards; Advanced Orbiting Systems (AOS), Networks and Data Links: Architectural Specification*, Blue Book, November 1992

2. National Aeronautics and Space Administration, Goddard Space Flight Center (GSFC), 515-3OCD/0194 (CSC/TR-94/6085), *Earth Observing System Data and Information System (EOSDIS) Test System (ETS) Operations Concept*, May 1995

3. --, Mission Operations and Data Systems Directorate (MO&DSD), 541-107 (CSC/SD-90/6059), *NASA Communications (Nascom) Access Protection Policy and Guidelines*, August 1995

4. --, 423-10-01-3, *Earth Science Data and Information System (ESDIS) Project Level 1 Requirements Volume 3: Other ESDIS Project Requirements*, October 1995

5. --, MO&DSD, 560-EDOS-0202.0004, *EDOS Functional and Performance Specification*, November 23, 1992

6. CCSDS, CCSDS 101.0-B-3, *Recommendation for Space Data System Standards; Telemetry Channel Coding*, Blue Book, May 1992

7. --, CCSDS 102.0-B-3, *Recommendation for Space Data System Standards; Packet Telemetry*, Blue Book, November 1992

8. --, CCSDS 201.0-B-1, *Recommendation for Space Data System Standards; Telecommand, Part 1: Channel Service, Architectural Specification*, Blue Book, January 1987

9. --, CCSDS 202.1-B-1, *Recommendation for Space Data System Standards; Telecommand, Part 2.1: Command Operation Procedures*, Blue Book, October 1991

10. --, CCSDS 203.0-B-1, *Recommendation for Space Data System Standards; Telecommand, Part 3: Data Management Service, Architectural Definition*, Blue Book, January 1987

11. --, CCSDS 301.0-B-2, *Recommendation for Space Data System Standards; Time Code Formats*, Blue Book, April 1990.

12. --, 515-4FRD/0294, *Earth Observing System Data and Information System (EOSDIS) Test System (ETS) Functional and Performance Requirements*, October 1995

2. System Description

ETS consists of three subsystems which are to be used to test and integrate different parts of EGS. The use of ETS throughout the EGS is illustrated in Figure 2-1. Sections 4.1 through 4.7 describes the scenarios. A brief description of each ETS subsystem and its functions follows.

2.1 ETS Low Rate System (ETS/LRS)

This subsystem has one major function. The ETS/LRS acts as an EDOS simulator for the EOC interface with the Spacecraft Integration and Test Facility (SCITF). Afterward, ETS/LRS will be used by the Flight Operations Team to communicate with SSIM for team training. ETS/LRS receives and transmits return and forward link data from the spacecraft or EOS AM-1 spacecraft simulator (SSIM).

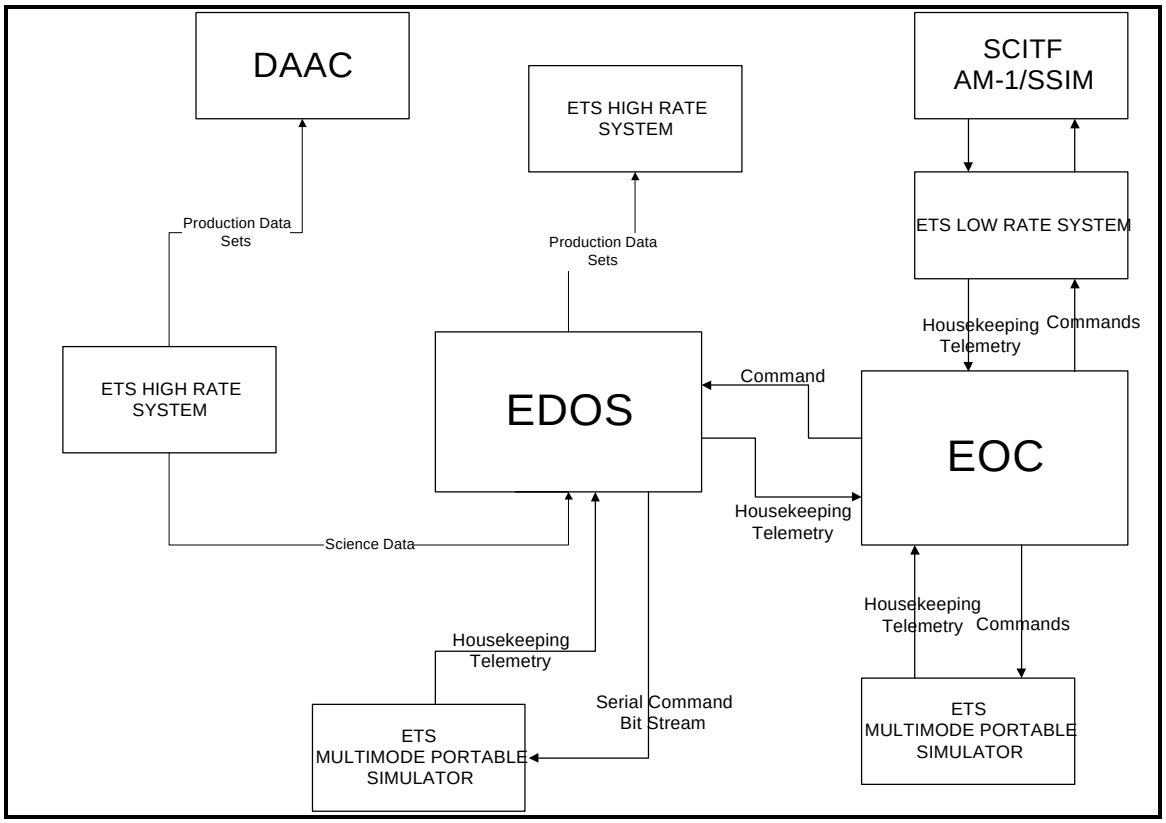

Figure 2-1. ETS Utilization with EGS

2.2 ETS High Rate System (ETS/HRS)

This subsystem has three major functions:

1. acting as an EDOS interface test tool, ETS/HRS generates and transmits science data at 150 Mbps, 45 Mbps or 34 Mbps. ETS/HRS is capable of processing science data tapes and transmitting the data to EDOS or the DAACs.
2. acting as an EDOS simulator, ETS/HRS transmits production and expedited data sets to the different DAACs.
3. acting as a DAAC simulator, ETS/HRS receives and logs production data sets transmitted to a DAAC.

2.3 ETS Multimode Portable System (ETS/MPS)

The primary function of the ETS/MPS is to simulate the AM-1 spacecraft. ETS/MPS can either interface directly with the EOS Operations Center (EOC), bypassing EDOS or transmits through EDOS. ETS/MPS generates a dynamic telemetry stream and responds to a limited number of spacecraft commands using the AM-1 project data base (PDB). ETS/MPS is portable and can be transported to a contingency site, where it interfaces with the equipment at the site or it can block the telemetry into 4800-bit blocks an act as a contingency site.

2.4 General Operations Interfaces

Figure 2-2 is an example of a basic scenario message flow. The SI&T Team creates the test plan, which include the steps of the test and descriptions of the recorded test data, including test anomalies, etc. The test plan lists the test objective and elements required, test data descriptions and acceptance criteria. The Test Conductor uses the test plan to notify all the participating elements and to ensure that all required equipment is scheduled and available. The ETS operator uses the test plan to generate the necessary test data and to configure ETS hardware/software. During the test, any errors encountered are reported to the Test Conductor. Error reports are submitted to the Test Conductor and discrepancy reports (DRs) are submitted to the DR data base. At the end of the test, the Test Conductor collects all the DRs, convenes a test debriefing session, and generates a test report.

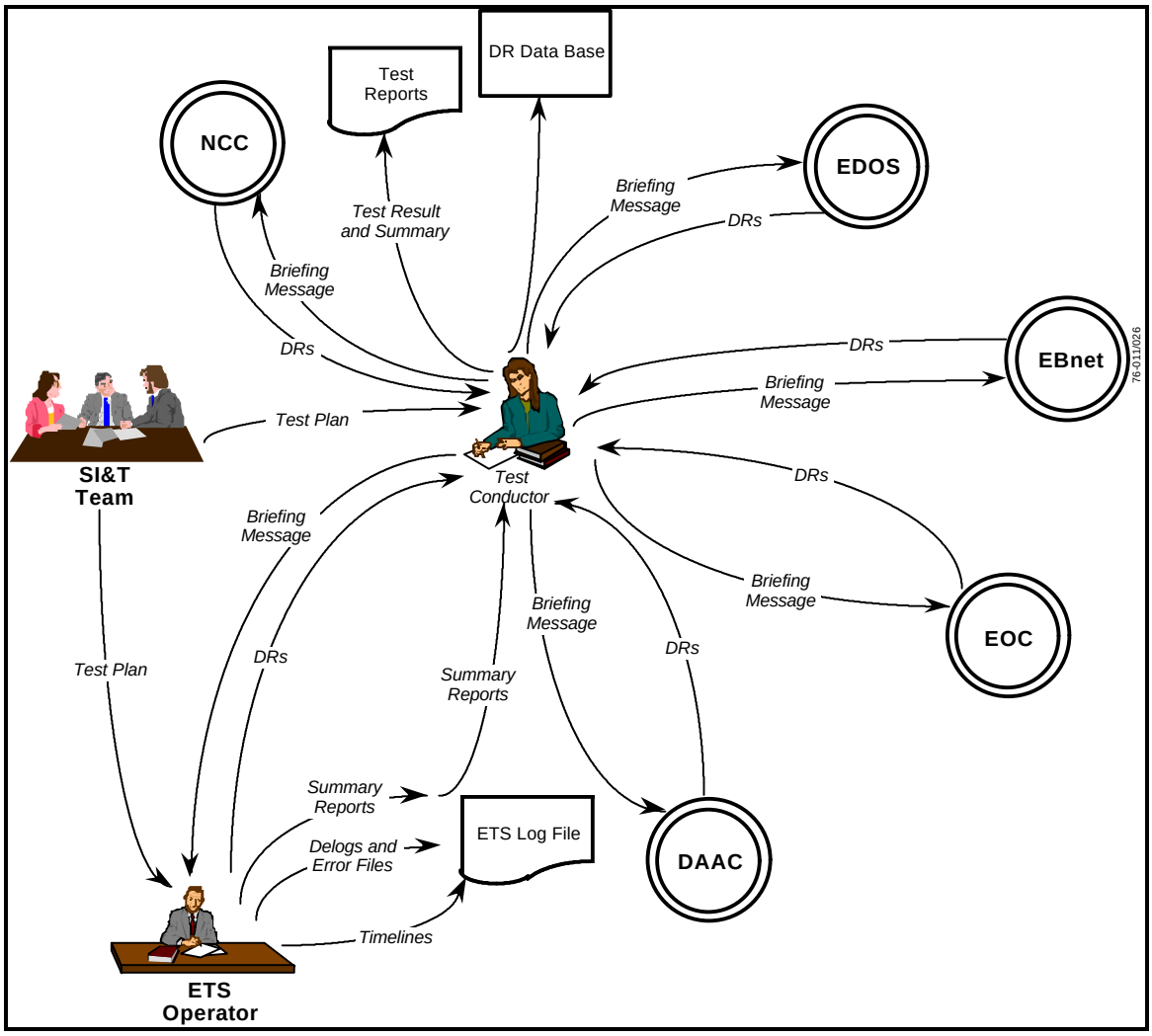

Figure 2-2. General Operations Interface

3. Personnel and Responsibilities

The following is a list of required personnel and a brief description of their responsibilities.

3.1 Test Conductor

Send Briefing Messages

The briefing message contains the following: a list of test participants, resources required, duration of the test and the test objective. The Test Conductor sends a briefing message to test participants, which may include the following:

- EBnet/NASCOM
- EOC
- EDOS
- DAACs
- NCC
- ETS Test Team
- RF SOC
- Spacecraft Integration Test Facility (SCITF)
- Contingency Sites Wallops Orbital Tracking Station (WOTS), Deep Space Network (DSN), and Ground Network (GN) sites

- Oversee the test.
- Review test procedures.
- Provide the ETS operator with test directions.
- Identify and submit DRs
- Collect DRs.
- Conduct post test debriefing.
- Generate the test report.

3.2 ETS Test Team

- Operate ETS.
- Create and load the test scripts.
- Configure ETS resources.

- Generate test statistics and reports (summaries, delogs, error logs)
- Submit DRs.
- Provide information to the debriefing session.

3.3 EBnet/NASCOM

- Configure and verify all data lines.
- Monitor data lines for any problems.
- Configure voice lines.
- Submit DRs.
- Provide information to the debriefing session.

3.4 EOC

- Generate command sequences.
- Monitor telemetry and command responses.
- Report any errors to the Test Conductor and submit DRs.
- Provide information to the debriefing session.

3.5 EDOS

- Receive, reformat and transmit low rate housekeeping data.
- Receive and transmit low rate forward commands.
- Receive and process high rate science data.
- Transmit production and expedited data sets to the DAACs or ETS.
- Report any errors to the Test Conductor and submits DRs.
- Provide information to the debriefing session.

3.6 DAACs

- Receive and processes production data sets.
- Report any errors to the Test Conductor and submits DRs.
- Provide information to the debriefing session.

3.7 NCC

- Schedule the TDRSS network.
- Monitor the network operations.
- Report any errors to the Test Conductor and submits DRs.

- Provide information to the debriefing session.

3.8 RF SOC

- Configure RF SOC equipment.
- Monitor data transfers.
- Report any errors to the Test Conductor and submits DRs.
- Provide information to the debriefing session.

4. ETS Scenarios

The following scenarios describe the interfaces that can be tested using ETS. Table 4 - 1 list the seven interface scenarios, the EGS interfaces, and ETS subsystem used in the testing of the interfaces.

Table 4 - 1 Scenario List

Scenario	ETS	AM-1/ SSIM	EOC	EDOS	Contingency Site	DAAC
EOC - ETS Interface Scenario	MPS		**X**	**X**		
Contingency Site Interface Scenario	MPS		**X**	**X**	**X**	
EDOS Interface Scenario	HRS			**X**		
EDOS - DAAC Interface Scenario	HRS			**X**		
DAAC - EDOS Interface Scenario	HRS					**X**
End to End Interface Scenario	MPS		**X**	**X**		
ETS SCTIF Interface Scenario	LRS	**X**	**X**			

4.1 EOC - ETS Interface Scenario # 1 (ETS/MPS)

As shown in Figure 4.1-1, this scenario describes the use of the ETS/MPS to verify the EOC capabilities to process low rate telemetry and transmit command sequences. The scenario is also used to create tests that will help validate the EOC operational and command procedures. During the early phases of the EOC development, the ETS/MPS will be used by the Flight Operations System (FOS) development team to test the EOC functions and later as training tool for the FOT.

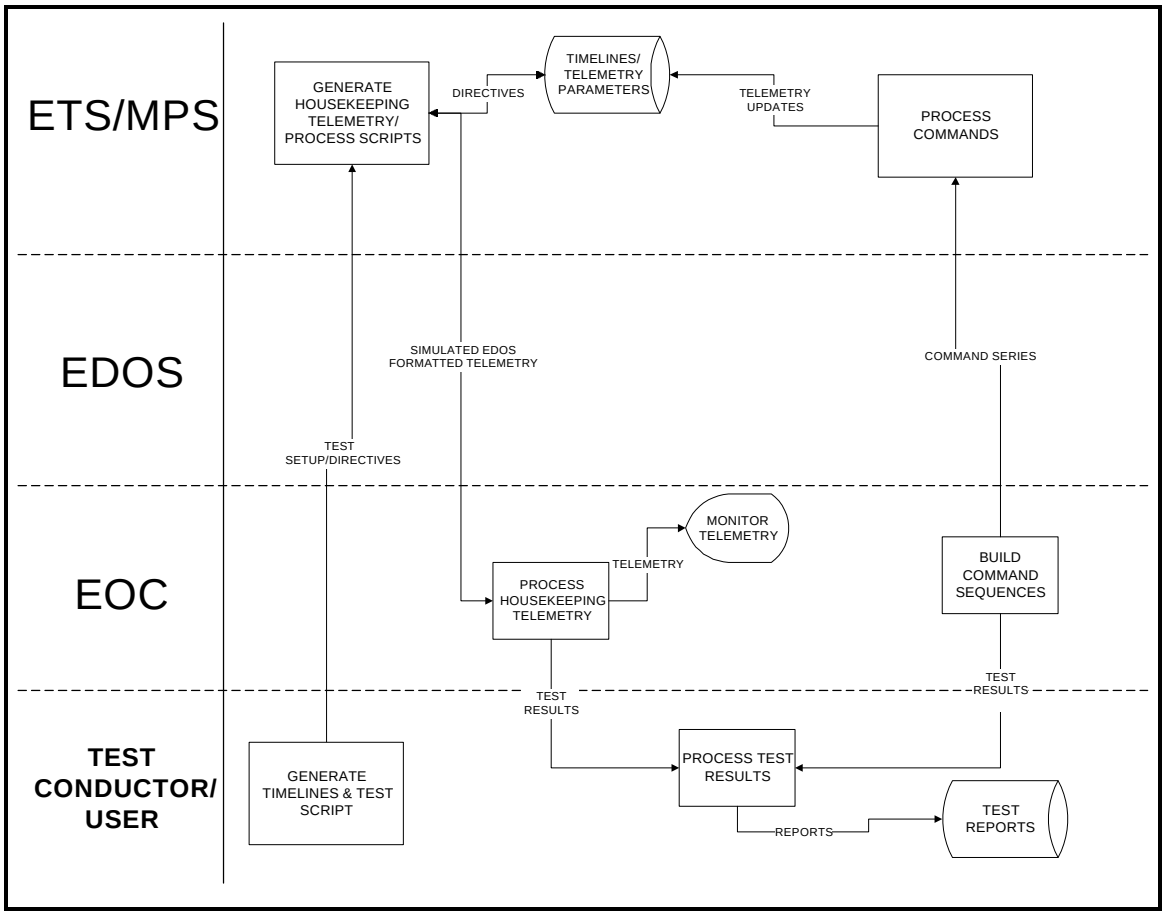

Figure 4.1-1 Scenario #1 Data Flow

4.1.1 Pre-test Activities

The pre-test activities for this scenario consist of the ETS/MPS operator verifying that the AM-1 telemetry and command data bases are current and correct. The ETS/MPS operator generates a timeline as described by the test plan provided by the SI&T Team. The timeline contains valid real-time ETS/MPS directives with time tags. The ETS/MPS operator configures all the ETS/MPS required hardware and software. EBnet/NASCOM configures all voice and data lines. The Test Conductor reviews the test procedure, sends a briefing message to the test participants, and ensures that all required equipment is available for the test.

4.1.2 Interface Scenario #1 Description

The ETS/MPS operator starts the scenario shown in Figure 4.1.2-1 by loading the ETS/MPS test timeline and configuring the ETS/MPS resources. The Test Conductor verifies that all participants are ready to start. The

ETS/MPS operator starts the test timeline. The timeline contains the test duration, simulated errors, and telemetry value settings. ETS/MPS generates simulated telemetry and transmits it to EOC. EOC processes the simulated telemetry and transmits commands as described in the timeline provided by the SI&T Team. At the end of the test, the ETS/MPS operator generates the summary reports and lists the error logs and delogs. The Test Conductor conducts the post-test debriefing and generates a test report. The same scenario can use to test with EDOS. In this mode ETS/MPS transmits the housekeeping data to EDOS and receives serial commands from EDOS.

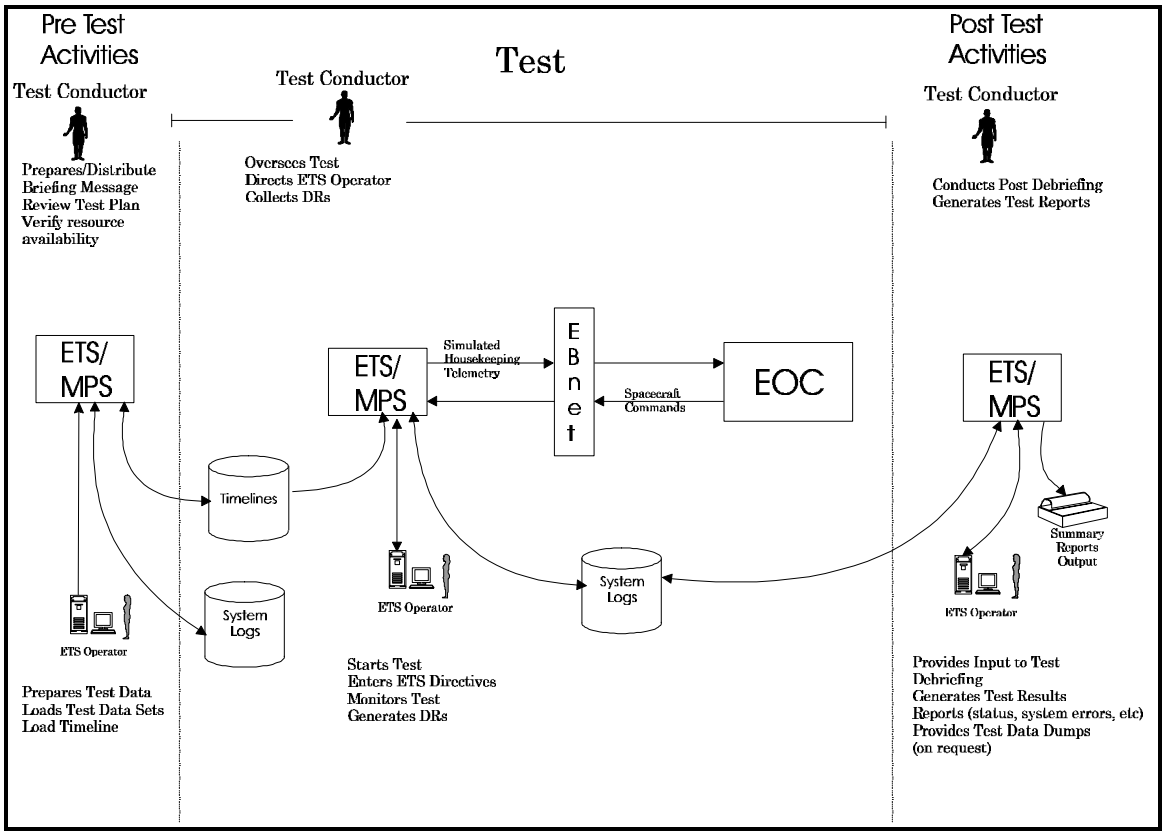

Figure 4.1.2-1 Interface Scenario #1

4.2 Contingency Site Interface Scenario #2 (ETS/MPS)

This scenario (Figure 4.2-1) describes how ETS/MPS is used to test the interface between the contingency sites, EDOS, and the EOC. The ETS/MPS is transported to the contingency sites, where it will interface with the site equipment. The ETS/MPS transmits simulated housekeeping data through the site to EDOS and receives/processes commands from EDOS. The contingency sites are WOTS, DSN and GN.

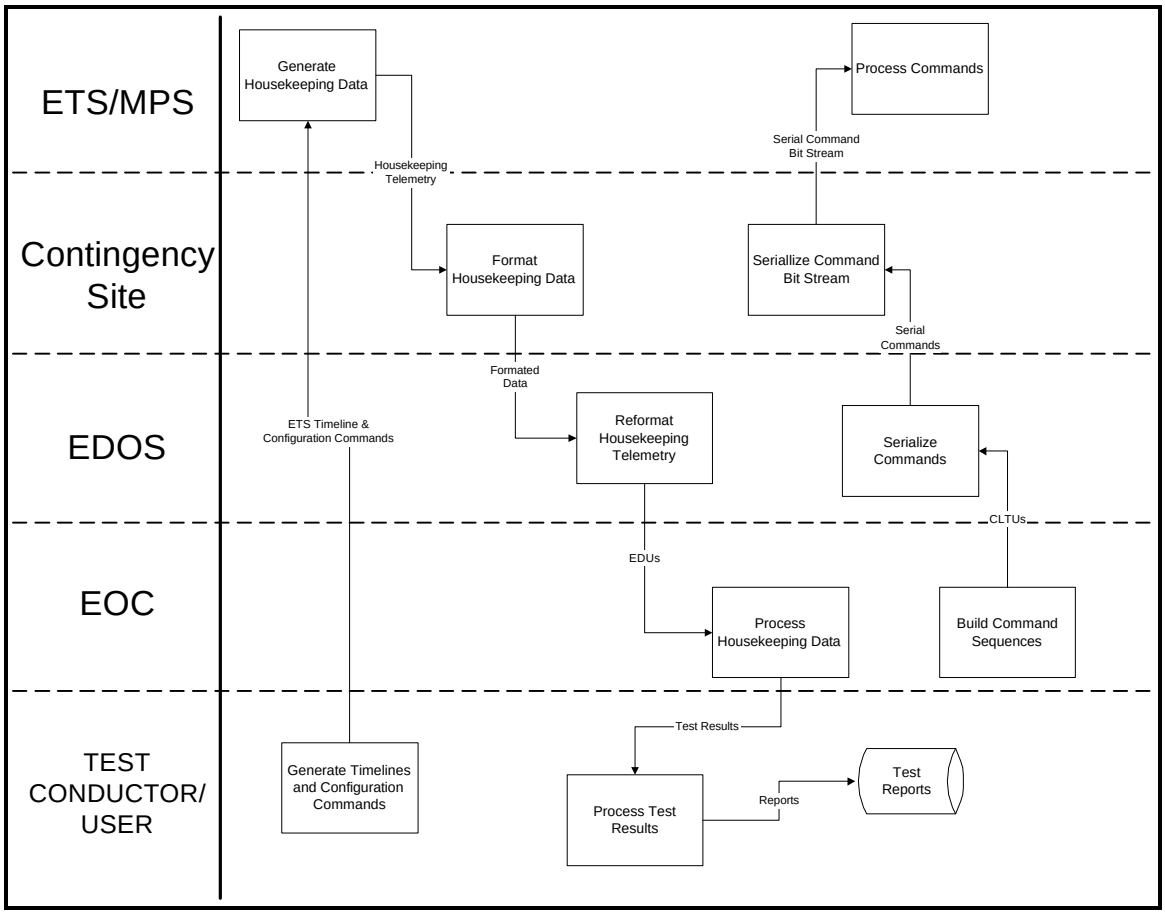

Figure 4.2-1 Scenario #2 Data Flow

4.2.1 Pre-test Activities

The pre-test activities for this scenario consist of the ETS/MPS operator verifying that AM-1 telemetry and command data bases are current and correct. The ETS/MPS operator generates a timeline as described by the test plan provided by the SI&T Team. The timeline contains valid real-time ETS/MPS directives with time tags. The ETS/MPS operator configures all the required hardware and software. Site personnel configure the site

equipment to interface with the ETS/MPS. EBnet/NASCOM configure all voice and data lines. The Test Conductor reviews the test procedure, sends a briefing message to the test participants, and ensures that all required equipment is available for the test.

4.2.2 Scenario #2 Description

The ETS/MPS operator starts the ETS/MPS, loads the test timeline, and configures ETS/MPS to interface with the site. The Test Conductor verifies that all participants are ready to start. The ETS/MPS operator starts the test timeline. The timeline contains the test duration, simulated errors, and telemetry value settings. ETS/MPS generates simulated telemetry and the contingency site transmits it to EDOS. EDOS transmits telemetry packets to the EOC and throughputs commands from the EOC to the ETS/MPS at the contingency site. The EOC processes the simulated telemetry and transmit commands. At the end of the test, the ETS/MPS operator generates the summary reports and lists the error logs and delogs. The Test Conductor conducts the post-test debriefing and generates a test report. This scenario is illustrated in Figure 4.2.2-1.

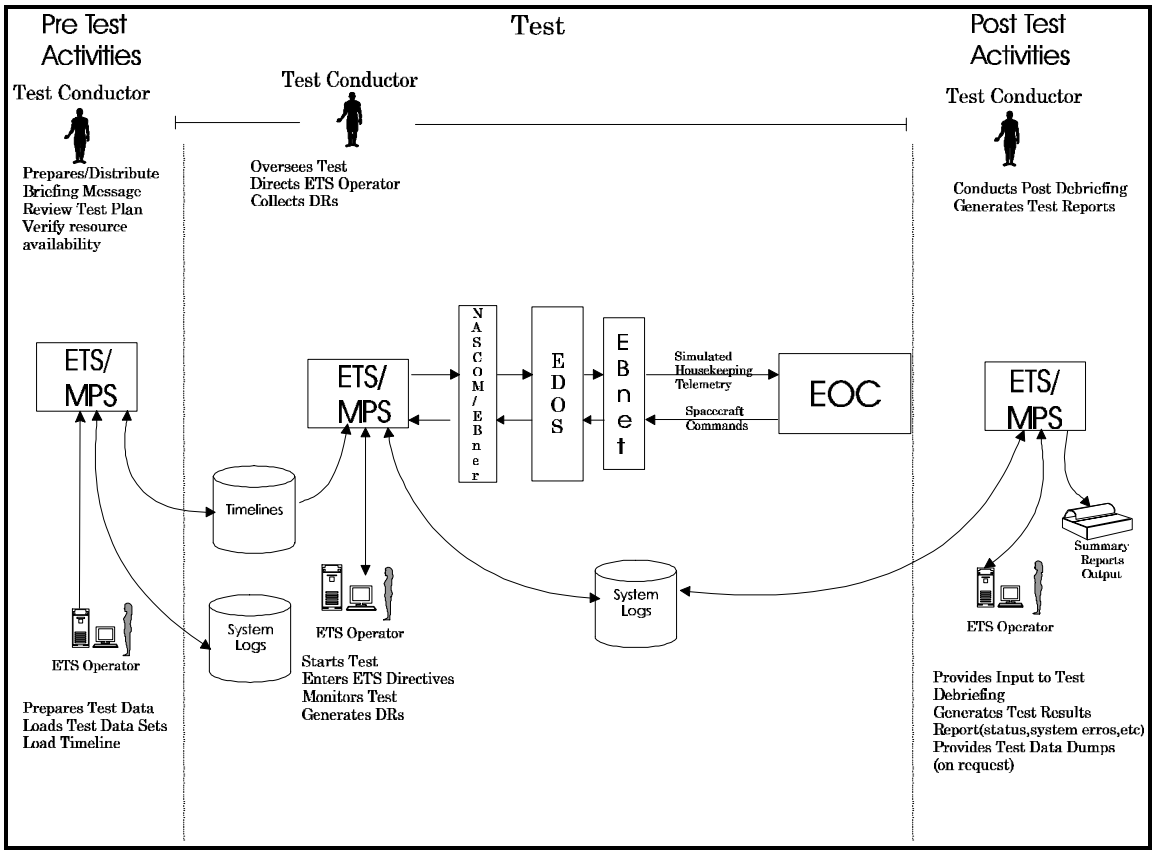

Figure 4.2.2-1 Interface Scenario #2

4.3 EDOS Interface Scenario #3 (ETS/HRS)

This scenario (Figure 4.3-1) is used to validate EDOS capability to process rate buffered science data (45 Mbps). The ETS/HRS is used to generate and transmit the pre-stored data to EDOS. EDOS should receive this data without any loss of data, process it into level 0 products, and transmit the products to the DAACs. This scenario has two pre-test and test conditions: (1) ETS/HRS is located at the GSFC (building 32) is used to generate and transmit science data directly to EDOS Processing Facility for level 0 processing, (2) ETS/HRS generates sciences data and transmits it to a tape recording system. The tape is sent to EDOS GSIF for use through the site system. Sciences data is rate buffered back to the EDOS Processing Facility, at GSFC, for level 0 processing.

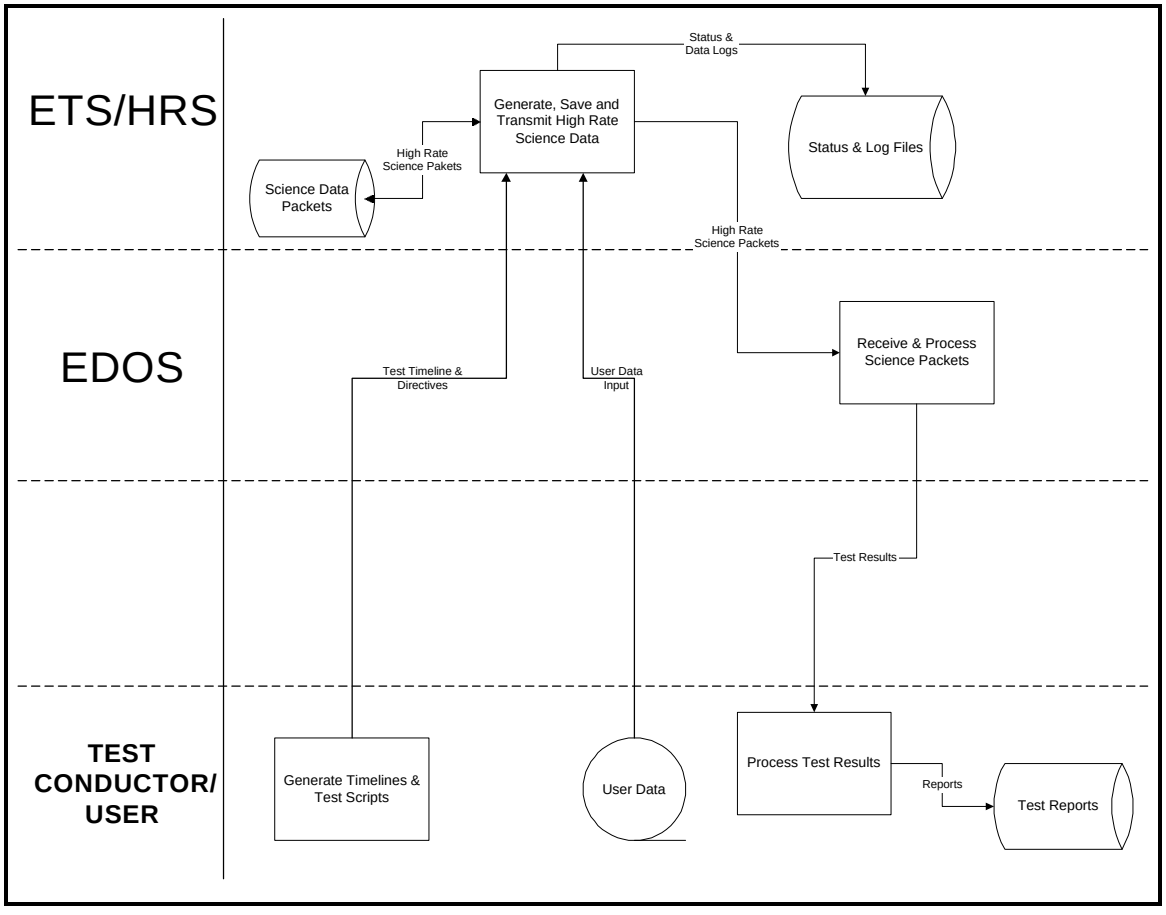

Figure 4.3-1 Scenario #3 Data Flow

4.3.1 Pre-test Activities

4.3.1.1 Pre-test for Test at GSFC

The pre-test activities for this scenario consist of the ETS/HRS operator generating a timeline as described by the test plan provided by the SI&T Team. The user has the capability of providing the ETS/HRS operator with a tape that contains science data. The timeline contains valid real-time operator directives with time tags. Using the test plan, the ETS/HRS operator generates the predefined test data and stores it to the disk. If user provides test data, the ETS/HRS operator uses the tape data to generate the high rate packets. The ETS/HRS operator configures all the ETS/HRS required hardware and software. EBnet/NASCOM configures all voice and data lines. EDOS is configured to receive the high rate packets. The Test Conductor reviews the test procedure, sends a briefing message to the test participants, and ensures that all required equipment is available for the test.

4.3.1.2 Pre-Test for Test at WSC

The ETS/HRS operator runs the timeline with the predefined parameters and actions. ETS/HRS generates the science data packets. The science data packets are transmitted to a tape recorder. The tape is sent to WSC for future use. Prior to running the test the Test Conductor reviews the test procedure, sends a briefing message to the test participants, and ensures that all required equipment is available for the test.

4.3.2 Scenario #3 Description

4.3.2.1 ETS Testing EDOS Interface at GSFC

The ETS/HRS operator starts the ETS/HRS. The ETS/HRS operator loads the test timeline and test data. The Test Conductor verifies that all participants are ready. The ETS/HRS operator starts the test timeline. The timeline contains the duration of the test and identifies the source of the data. All the test activities are monitored by the Test Conductor and the participating elements. Configuration data and status information are logged for later processing and analysis. ETS/HRS transmits the high rate data to EDOS. At the end of the test, the ETS/HRS operator generates the summary reports and lists the error logs and delogs. The Test Conductor conducts the post-test debriefing and generates a test report. Figure 4.3.2.1-1 illustrates this scenario.

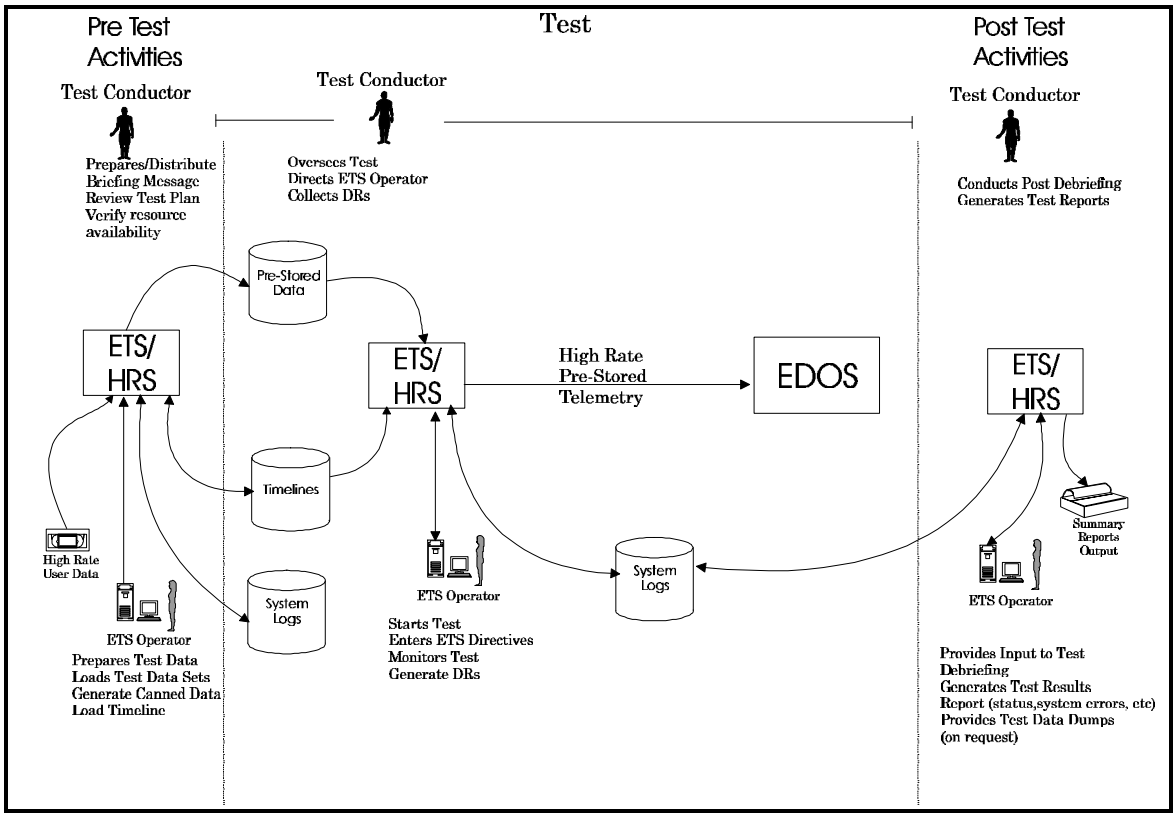

Figure 4.3.2.1-1 Interface Scenario #3

4.3.2.2 ETS Testing EDOS Interface at White Sands Complex

The ETS generated tape is playback through the WSC equipment. The data is transmitted to EDOS at GSFC via commercial lines. EDOS processes the data and generates the PDS. At the conclusion of the test, the Test Conductor conducts a post test debriefing and generates a test report.

4.4 EDOS-DAAC Interface Scenario # 4 (ETS/HRS)

This scenario (Figure 4.4-1) is used to verify the interface between EDOS and the DAACs. The ETS/HRS, simulating a DAAC, receives the data sets from EDOS. ETS/HRS transmits and receives operations management data (OMD) to and from EDOS.

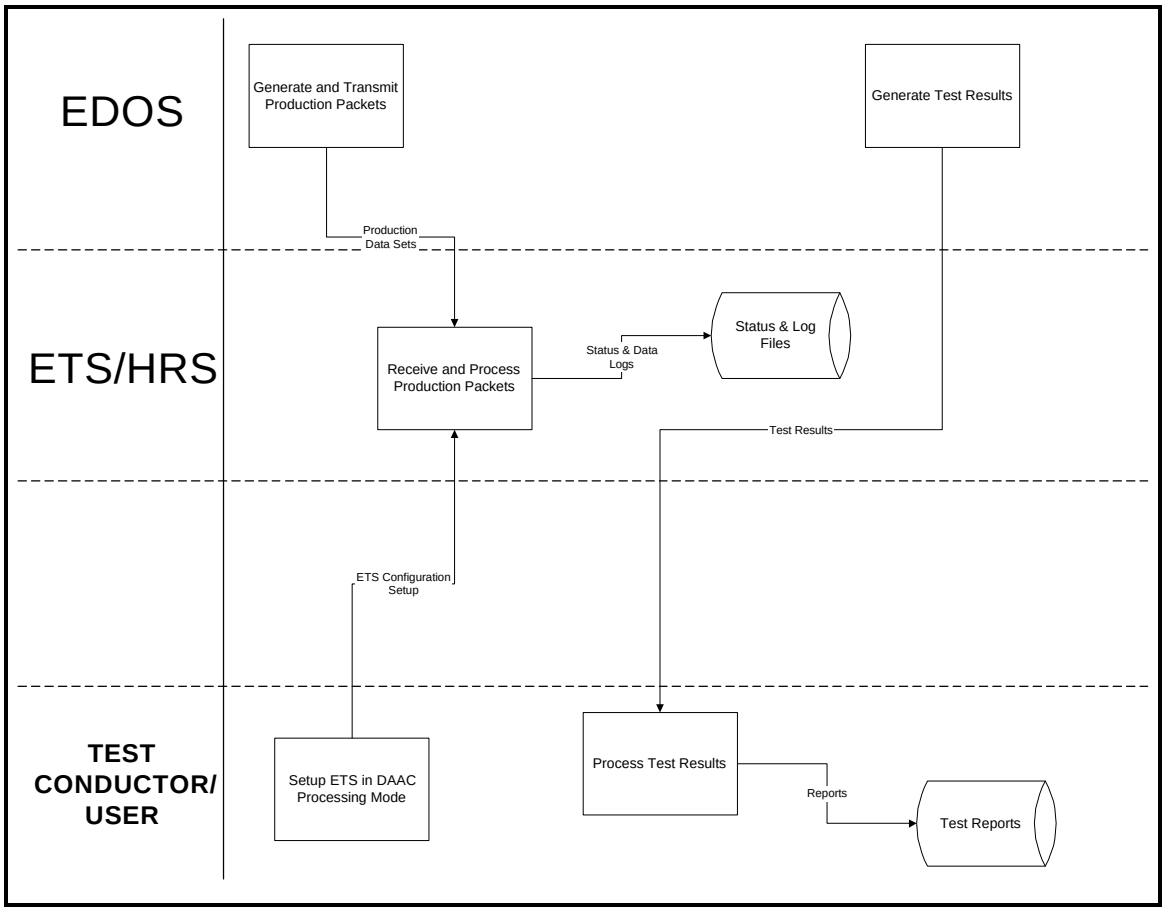

Figure 4.4-1 Interface Scenario #4

4.4.1 Pre Test Activities

The pre-test activities for this test scenario consist of the ETS/HRS operator preparing the test data sets containing Level 0 (L0) data. These data sets can be generated by ETS/HRS or processed from user provided tapes. The ETS/HRS operator configures all the required ETS/HRS hardware and software. EBnet/NASCOM configures all voice and data lines. The Test Conductor reviews the test procedure, sends a briefing message to the test

participants, and ensures that all required equipment is available for the test.

4.4.2 Scenario #4 Description

The Test Conductor verifies that all participants are ready to start. The ETS/HRS operator starts the ETS/HRS. ETS/HRS is configured to the DAAC mode ready to receive and log data. EDOS transmits the L0 products. At the end of the test, the ETS/HRS operator generates the summary reports and lists the error logs and delogs if verification or comparison checks are requested. The Test Conductor conducts the post-test debriefing and generates a test report. This scenario is illustrated by Figure 4.4.2-1.

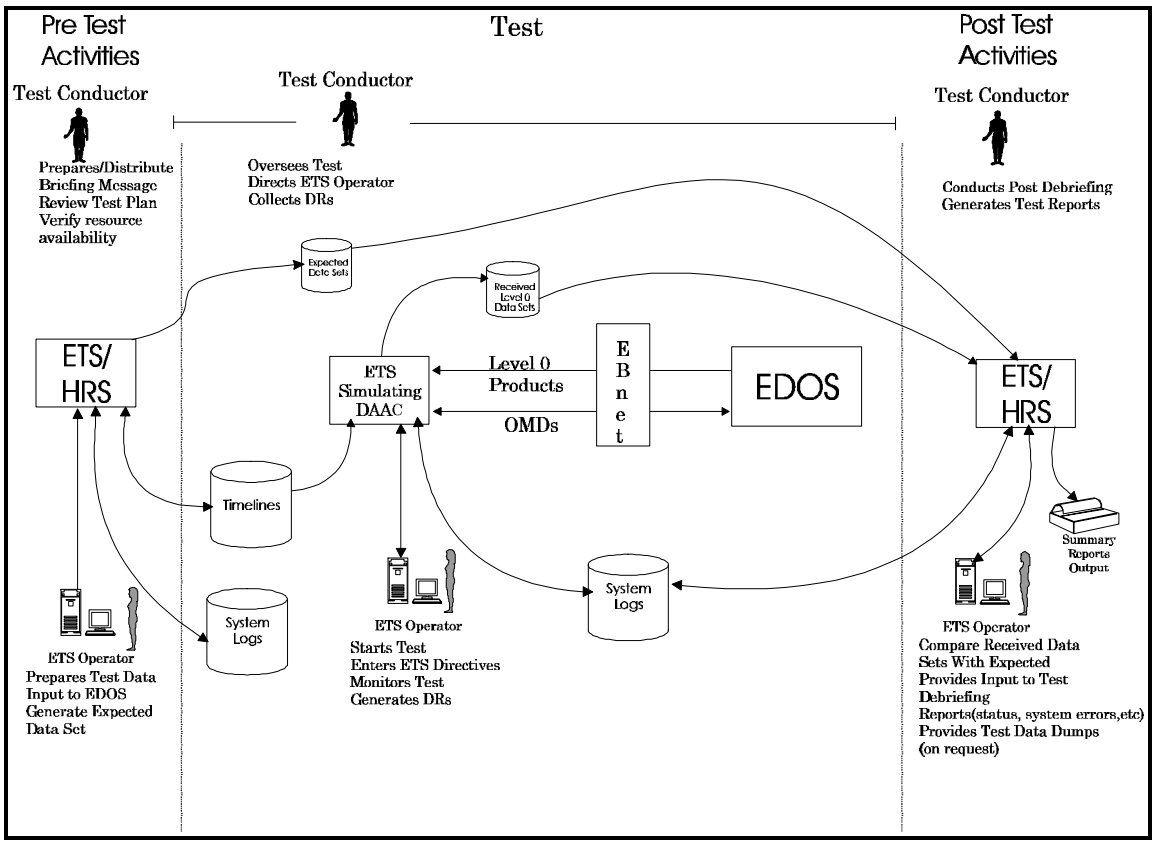

Figure 4.4.2-1 Interface Scenario #4

4.5 DAAC-EDOS Interface Scenario # 5 (ETS/HRS)

This scenario (Figure 4.5-1) describes how ETS/HRS is to be used to verify EDOS interface with the DAACs. ETS/HRS is used to simulate EDOS by transmitting EDOS products to the different DAACs. In this scenario, ETS/HRS also exchanges OMD messages with the DAACs.

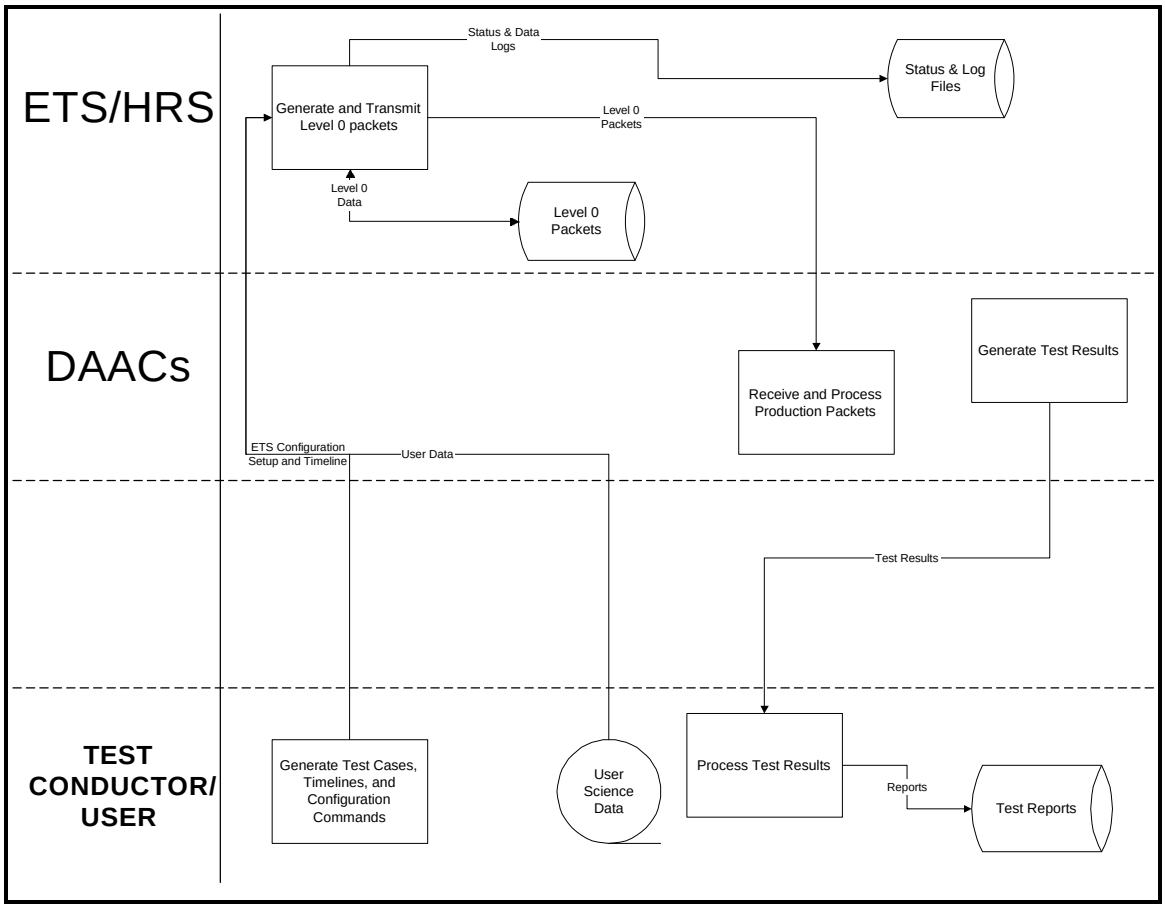

Figure 4.5-1 Scenario #5 Data Flow

4.5.1 Pre-test Activities

The pre-test activities for this scenario consist of the ETS/HRS operator generating production data sets as described in the test plan or loading the data from tape. The ETS/HRS operator configures the ETS/HRS to transmit production data set to the DAAC. The ETS/HRS operator configures all the required hardware and software. EBnet/NASCOM configures all voice and data lines. The Test Conductor reviews the test procedure, sends a briefing message to the test participants, and ensures that all required equipment is available for the test.

4.5.2 Scenario #5 Description

The Test Conductor verifies that all participants are ready to start. The ETS/HRS operator starts the ETS/HRS. ETS operator configures ETS/HRS to transmit pre-stored data sets. The DAACs receive and process the data sets. At the end of the test, the ETS/HRS operator generates the summary reports and lists the error logs and delogs. The Test Conductor conducts the

post-test debriefing and generates a test reports. This scenario is illustrated by Figure 4.5.2-1.

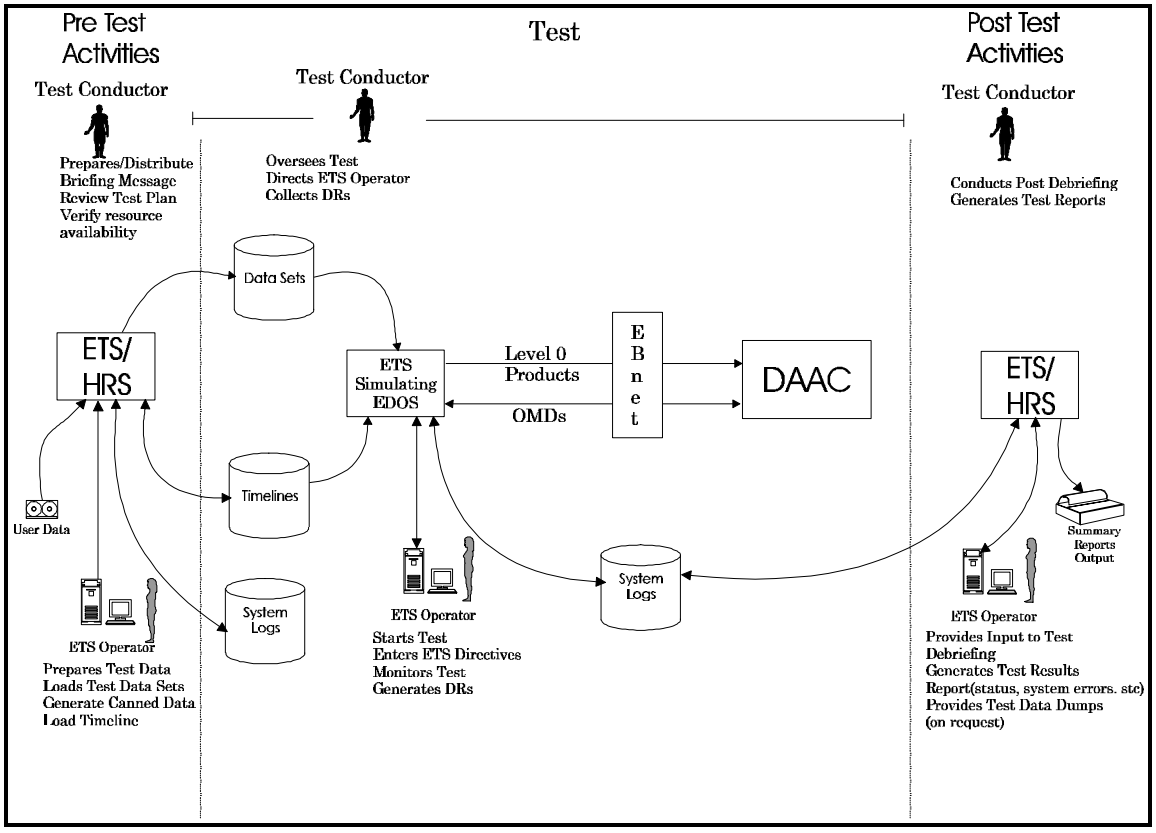

Figure 4.5.2-1 Scenario #5 Interface

4.6 End-to-End Interface Scenario # 6 (ETS/MPS)

This scenario (Figure 4.6-1) describes how ETS/MPS is to be used to test the ESDIS ground network interfaces. ETS/MPS is used to generate simulated telemetry and receive commands through TDRS and the White Sands Complex (WSC).

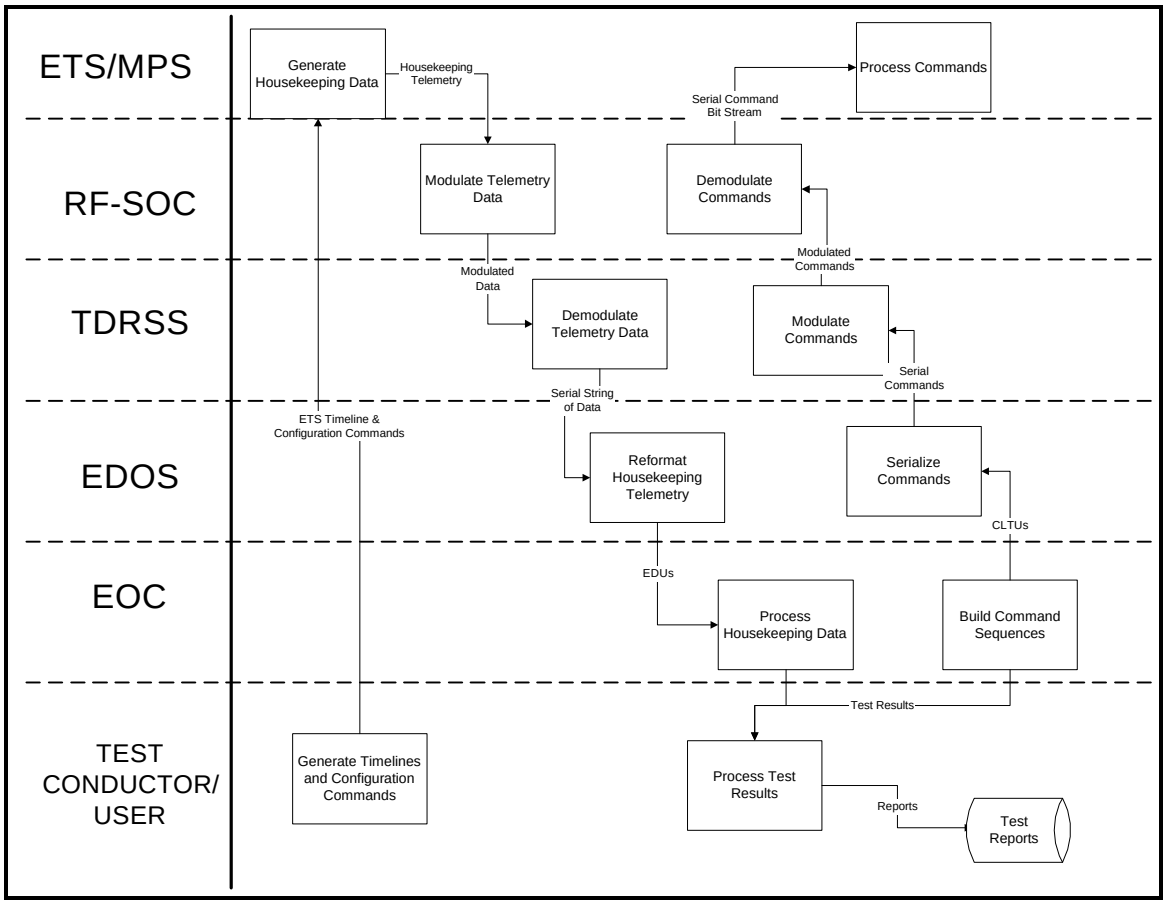

Figure 4.6-1 Scenario #6 Data Flow

4.6.1 Pre-test Activities

The pre-test activities for this scenario consist of the ETS/MPS operator verifying that AM-1 telemetry and command data bases are current and correct. The operator generates a timeline as described by the test plan provided by the SI&T Team. The timeline contains valid real-time operator directives with a time tag. The ETS/MPS operator configures all the required hardware and software. The RF SOC operator configures the RF equipment. The NCC schedules the network resources. EBnet/NASCOM configures all

voice and data lines. The Test Conductor reviews the test procedure, sends a briefing message to the test participants, and ensures that all required equipment is available for the test.

4.6.2 Scenario #6 Description

The ETS/MPS operator starts the ETS/MPS. The ETS/MPS operator loads the test timeline and configures ETS resources. The Test Conductor verifies that all participants are ready to start. The ETS/MPS operator starts the test timeline. The timeline contains the duration of the test, the simulated errors, and telemetry value settings. ETS/MPS generates simulated telemetry and transmits it to EDOS via the RF SOC and TDRS though the WSC. EDOS transmits telemetry packets to the EOC and throughput commands from the EOC to the ETS/MPS via WSC through TDRS and the RF SOC. The EOC processes the simulated telemetry and transmits commands according to the timeline provided by test team. At the end of the test, the ETS/MPS operator generates the summary reports and lists the error logs and delogs. The Test Conductor conducts the post-test debriefing and generates a test report. Figure 4.6.2-1 illustrates this scenario.

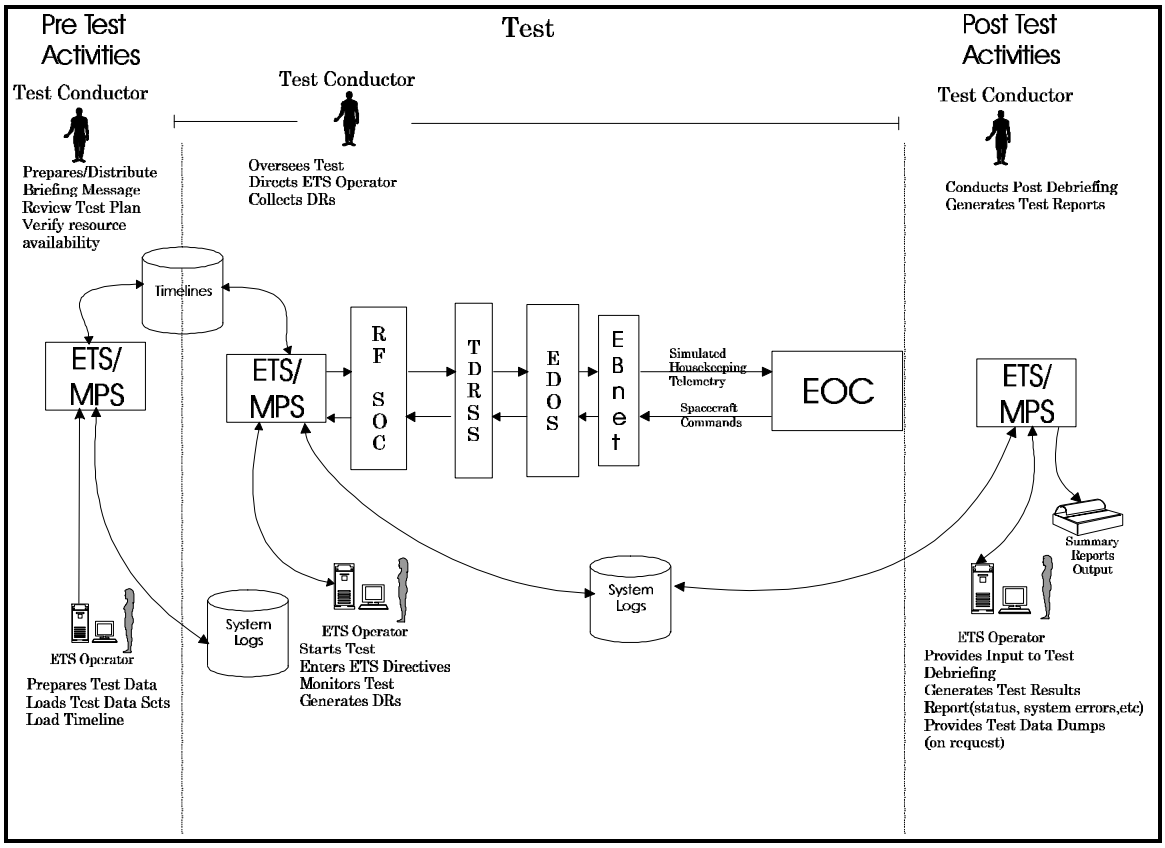

Figure 4.6.2-1 Interface Scenario #6

4.7 ETS/LRS-SCITF Interface Scenario #7 (ETS/LRS)

This scenario (Figure 4.7-1) describes the ETS/LRS capability to emulate EDOS capability to provide low rate forward and return link processing functions. These functions are required by the EOC to interface with the AM-1 spacecraft and the AM-1 simulator, SSIM. ETS/LRS receives forward link command blocks from the EOC and transmits them as serial commands to the spacecraft or simulator. For the return link, ETS/LRS receives the serial bit stream, in the form of channel access data units (CADUs); performs the EDOS front-end processing function; and transmits the telemetry packets as EDOS data units (EDUs) to the EOC.

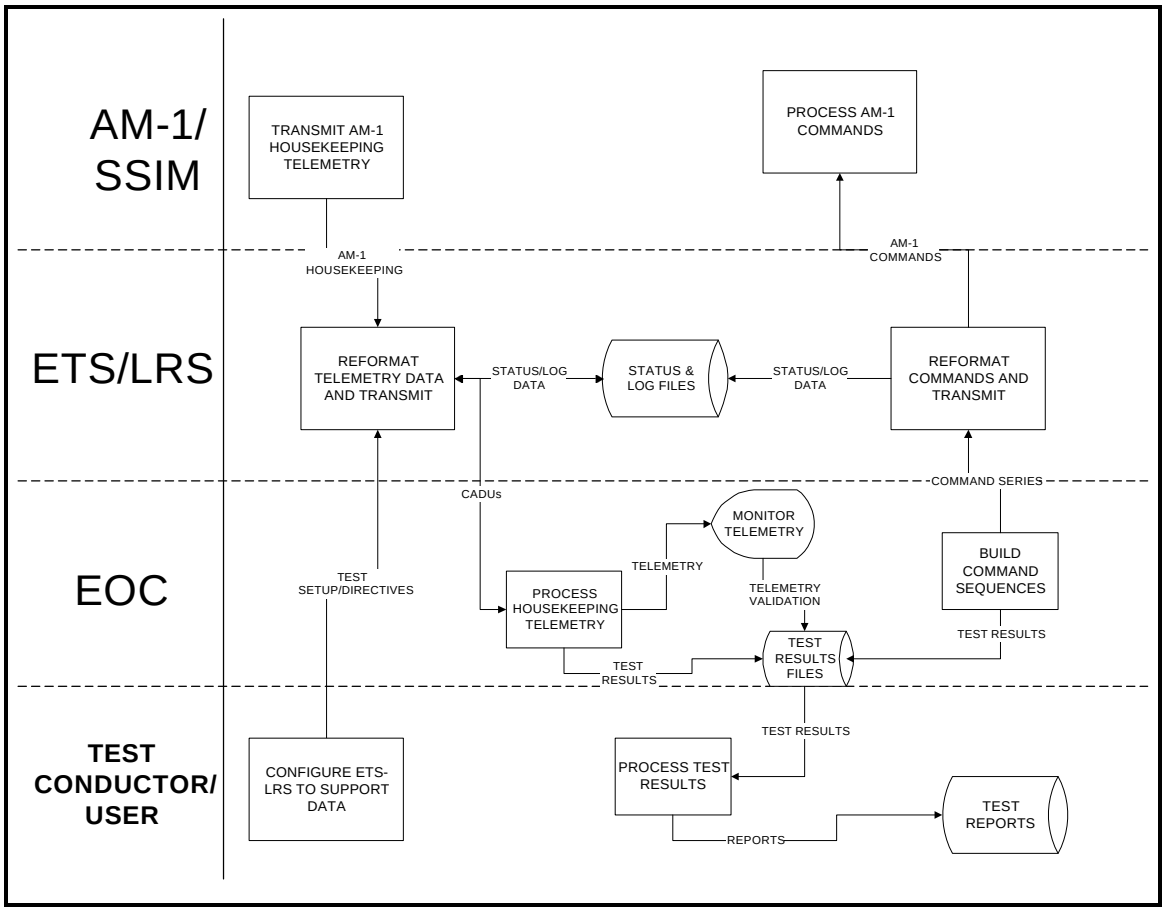

Figure 4.7-1 Scenario #7 Data Flow

4.7.1 Pre-test Activities

The pre-test activities for this scenario consist of the ETS/LRS operator configuring the ETS/LRS. EBnet/NASCOM configures all voice and data

lines. The Test Conductor reviews the test procedure, sends a briefing message to the test participants, and ensures that all required equipment is available for the test.

4.7.2 Scenario #7 Description

The ETS/LRS operator starts the ETS/LRS and configure hardware and software for this mode. The Test Conductor verifies that all participants are ready to start. ETS/LRS processes the return and forward data. The EOC processes the simulated/real telemetry and transmits commands. At the end of the test, the ETS/LRS operator generates the summary reports and lists the error logs and delogs. The Test Conductor conducts the post-test debriefing and generates a test report. Figure 4.7.2-1 illustrates this scenario.

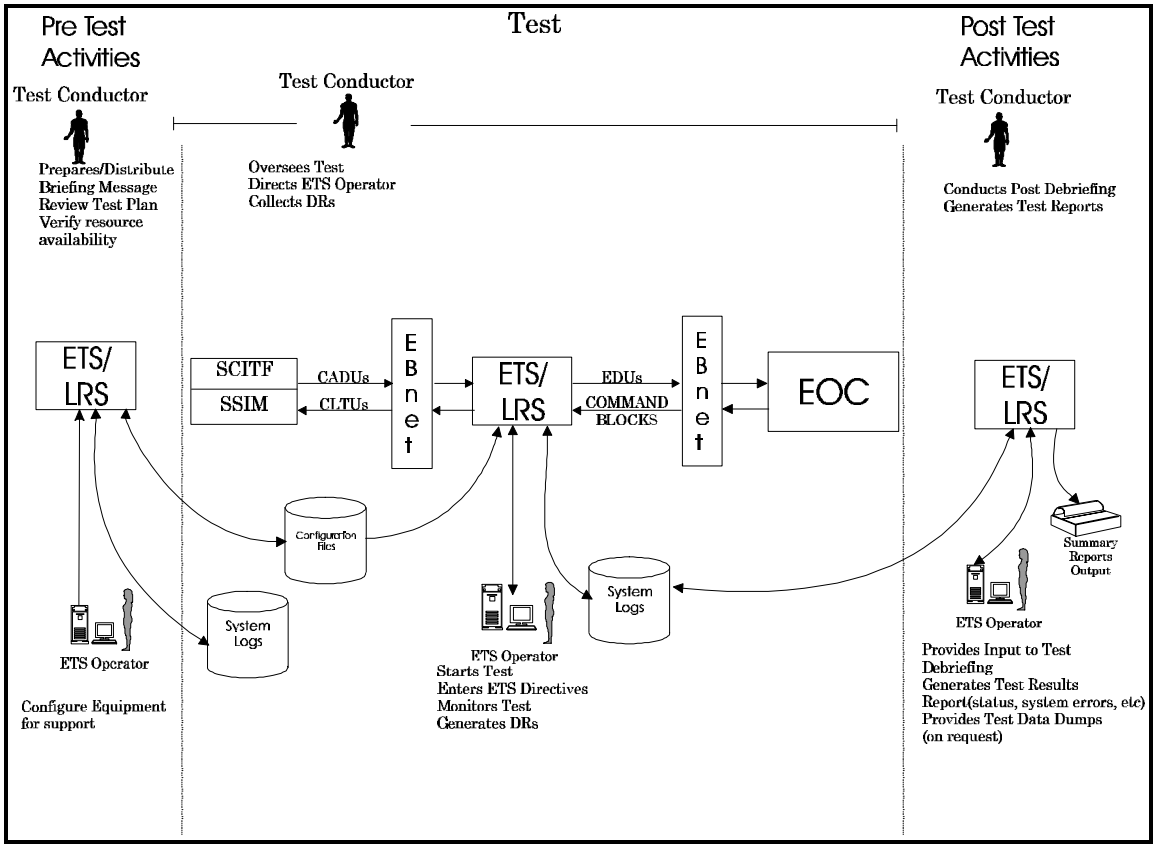

Figure 4.7.2-1 Scenario #7 Data Flow

Abbreviations and Acronyms

AM-1	morning equatorial crossing spacecraft
CADU	channel access data unit
CLCW	command link control word
CLTU	command link transmission unit
COP	Command Operation Procedures
CVCDU	coded virtual channel data unit
DAAC	Distributed Active Archive Center
DR	Discrepancy Report
DSN	Deep Space Network
EBnet	EOSDIS Backbone Network
EDOS	EOS Data and Operations System
EDS	expedited data set
EGS	EOS ground system
EDU	EDOS data unit
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ESDIS	Earth Science Data and Information System
ETS	EOSDIS Test System
FOS	Flight Operations System
FOT	Flight Operations Team
GN	Ground Network
GSFC	Goddard Space Flight Center
kbps	kilobits (thousands of bits) per second
L0	Level 0
Mbps	megabits (millions of bits) per second
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
NCC	Network Control Center
OMD	operations management data
PDS	production data set
PDU	protocol data unit
RF SOC	Radio Frequency Simulation Operations Center
SCID	spacecraft identifier
SCITF	Spacecraft Integration and Test Facility
SI&T	System Integration and Test
SN	Space Network
SSIM	EOS AM-1 spacecraft simulator
TBD	to be determined
TBR	to be resolved
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TGT	TDRSS Ground Terminal
TSS	TDRS service session
WSC	White Sands Complex
WOTS	Wallops Orbital Tracking Station